

CHAPTER 14

MAINTENANCE

Reliable communications depend greatly upon the equipment operating at optimum efficiency. Maintenance of material is a major factor contributing to battle readiness; because it is essential that none of the features of shipboard maintenance be overlooked or neglected, a continuing maintenance program is needed to avoid equipment failures at crucial moments. The program itself must provide command and all subordinate supervisory levels with the tools for effectively planning, directing, and controlling all preventive maintenance requirements within the ship.

Maintenance may be broken down into three broad categories.

1. Corrective maintenance: the sum of those actions required to restore equipment to an operational condition within predetermined tolerances or limitations.

2. Preventive maintenance: the sum of those actions performed on operational equipment that contribute to uninterrupted use of the equipment within design characteristics.

3. Checks: standard procedures to determine if the current operational status of an equipment is within the tolerances and limitations of the designed performance standards. When carried out at prescribed intervals, checks are a part of preventive maintenance.

For a maintenance program to be effective, at least the following conditions are necessary:

1. The program must be realistic and within the capabilities of the ship's force to accomplish.

2. Operating personnel should conduct all of the preventive maintenance on the equipment they operate.

3. All personnel should understand the necessity for and importance of maintenance.

4. Persons conducting preventive maintenance should be familiar with sources of information on maintenance procedures.

5. An on-the-job training program must be pursued to attain and retain individual maintenance proficiency.

Communication personnel should have the direct responsibility of both maintaining and

operating the ship's communication equipment. The alternative to this procedure is that, when equipment malfunctions, repairs are scheduled along with needed repairs to other shipboard electronic equipment. The main disadvantage of such a system is that if several different types of equipment are in need of repair simultaneously, a shortage of ETs may necessitate a delay in the correction of one type or another. If communication equipment, which in need of repair is given a low priority as compared to—say—radar gear, the communication force might have to improvise in assigning equipment, which could prove a severe handicap.

It should be immediately obvious that the better trained the operators are in the maintenance and repair of their equipment, the more assurance the ship has that effective communications will not be disrupted because of a routine casualty or outage.

MAINTENANCE POINTERS

To be effective, a preventive maintenance program must be systematic, and it must be laid out in an orderly fashion to accomplish prescribed items of work at regular intervals.

To actually prevent a breakdown, there isn't much we can do. A tube that tests satisfactorily today, for example, may go out tomorrow. The only work that is preventive is of a mechanical nature: lubrication, checking tube clamps and electrical connections for tightness, repairing frayed leads, and the like. But this does not mean that the preventive maintenance program should stop there. About half the secret of a successful program lies in detecting small troubles as they occur, and having them corrected before they get beyond control.

The big problem in any preventive maintenance program is training people to know what to look for, to ensure that they look for those signs of trouble, and finally to make certain that they are reported as soon as they appear. Attaining such a goal and overcoming the obstacles placed in its way require constant

attention by all hands, as well as some kind of continuing training program.

To ensure that his assigned equipments are in fact being maintained properly, the communication officer himself must make frequent inspections. Routine material inspections by the commanding officer or the department head are no substitute for thorough examinations by the person directly responsible for upkeep and repair. Periodic maintenance checks by specifically named persons are extremely important. Whenever possible, these checks should be verified personally by the communication officer. Because a check is ticked off as accomplished is no automatic guarantee that the job actually was done.

This section is confined to a general discussion of matters to be considered in connection with maintenance of radio equipment.

TRANSMITTERS AND RECEIVERS

Transmitters and receivers are comparatively sensitive and delicate machines. As such, they are subject to the abuses of every man-used instrument. The conditions of shock, temperature control, and climatic variations to which they are subjected aboard naval ships are severe.

Salt particles and dust are the worst enemies of receiving and transmitting equipment. An accumulation of dust prevents proper cooling, which, in turn, causes the rapid deterioration of circuit components. Salt corrodes contacts and can damage the equipment severely. Every transmitter and receiver should be cleaned periodically with a vacuum cleaner.

The equipments should be turned on daily to (1) ensure that they are working properly, and (2) prevent damage due to the accumulation of moisture. An operator should check the controls each day to troubleshoot for binding, excessive play, or loose knobs. He should ensure that spare fuses of the correct type and rating (usually secured on clips inside access doors) are ready for instant use.

Loose cable couplings and bonding straps, burned-out pilot lights, and broken meter glasses should be repaired or replaced immediately. All sliding mechanical contacts should be lubricated lightly with nonfluid mineral oil or petrolatum. Because lint and dust accumulate easily on these contacts, they should be cleaned frequently.

ELECTRON TUBES

The most common cause of communication equipment casualties is electron tube failure. A tube also may be operating considerably below standard, and in some instances this substandard performance may not be apparent even in a tube test. The average tube tester applies a 60-cycle sine wave to a tube, whereas in actual performance the tube is expected to handle extremely wide frequency ranges.

A few critical circuits are tuned to the characteristics of the particular tube installed. Replacement with another tube of the same design may, in fact, detune the circuit, resulting in poor equipment performance.

Some tubes perform satisfactorily in an equipment but do not check "good" in the tester. Conversely, some tubes that test "satisfactory" may not perform well in actual use. This explanation is not intended to imply that the shipboard tube tester should not be used, but one should treat its indications with reservations.

Many tubes in common use aboard ship cannot be tested in an ordinary tube tester. Notably, the list includes high-powered transmitter and modulator tubes, klystron oscillators, and magnetrons. The following tube-testing policy is suggested.

1. Tubes should not be tested merely as a matter of routine. The results obtained do not justify the work and time involved. Test tubes only when the equipment shows signs of improper operation, and do not rely too heavily on the results unless the tube is shown to be completely bad.

2. When testing tubes, each tube must be replaced in its original socket to avoid detuning critical circuits. It is quite easy to put a tube of one type into a socket designated for another type, because so many different tubes use the standard octal socket.

MOTORS AND GENERATORS

Motors and generators are capable of extended operation without mishap and with very little care. They often are neglected, however, and casualties, which easily could have been prevented, occur.

The units should be protected from moisture, dirt, and friction. Carbon dust, which collects near the commutator as the result of the wearing of the carbon brushes, should be removed periodically with a vacuum cleaner. Use of a

blower may force foreign matter into the windings and bearings, and for this reason the practice should be prohibited. To ensure proper ventilation, loose gear must not be stowed near any motor or generator; overheating is a major cause of casualties.

Bearings

The greatest single source of motor and generator failures is bearing casualties. Lack of proper lubrication and excessive lubrication contribute to these breakdowns. The manufacturer's instruction books specify the proper grade of lubricant and method of application.

Two types of ball bearings are in general use: the grease-lubricated bearing and the permanently lubricated sealed bearing. Grease-lubricated bearings require periodic lubrication. Sealed bearings are permanently lubricated by the manufacturer, are sealed, and need no additional lubrication throughout their service life.

Sealed bearings installed in an equipment should be replaced, when necessary, only with bearings of the same type. If not already provided, nameplates reading "do not lubricate" should be attached to the bearing housing.

Some Navy equipment is oil-lubricated, and have approved lubrication charts furnished. The latter should be obeyed exactly; great harm can be caused by excessive lubrication.

Brushes and Holders

Brushes, which are sticks of carbon, should move freely in their holders. Sufficient spring tension should exist to ensure firm contact with the commutator. The area of the commutator where the brushes bear should be a chocolate-brown color. Carbon dust tends to prevent free movement of the brushes in their holders, and the dust must be removed at frequent intervals. If the commutator is scored, it may be repaired by a tender or, for small generators, by ship's force personnel using a commutator stone. Small copper particles adhering to the brushes are the usual cause of scoring of the commutator.

When insulation resistance readings are being made of the windings, the results should be recorded on the appropriate history card for the machine.

ANTENNAS

Maximum communication efficiency depends on properly maintained antenna systems. Because of their location high in the ship, they are subject to the corrosion of salt spray and stack gases. Vibration and wind may cause such damage as broken strands and broken couplings and brackets, which are not located easily by visual inspection. Improper painting also contributes to antenna troubles. Paint, salt, and soot can reduce antenna efficiency considerably by shorting the signals around the insulators. This is a major factor in poor UHF communications.

When one considers the many enemies of antenna systems, their reliability and effectiveness are remarkable. A reasonable amount of preventive maintenance is sufficient to ensure satisfactory and consistent performance.

Antennas should be lowered and inspected whenever the opportunity presents itself. Deterioration at clamps and lead-ins is a common fault. Nicks and kinks should be avoided because they tend to weaken the wire. Soot and salt spray should be removed; insulators should be wiped clean, and all paint removed. Do not use a wire brush on insulators; cleaning without resorting to wire brushes is always preferable.

Whip antennas, which may collect moisture in their hollow centers, should be inspected and cleaned when opportunity permits.

AIR FILTERS

Many modern electronic equipments are cooled by forced air, which involves the movement of a large volume of air within the units. The air is filtered to keep out dust and other foreign particles. If the filters are efficient, they remove most of this foreign material from the air that passes through them.

An analysis of the failures of parts in electronic equipment indicates that many failures can be traced to excessive heat caused by dirty air filters. The cleaning of air filters is exceedingly important for the proper operation of electronic equipment. For some reason (perhaps their importance is not fully recognized) it appears that air filters often are neglected or disregarded until excessive heating causes a breakdown of the equipment.

SAFETY PRECAUTIONS

If a 60-cycle alternating current is passed through a man from hand to hand or from hand

to foot, the effects when current gradually is increased from zero are as follows:

1. At about 1 milliampere (0.001 ampere) the shock can be felt.
2. At about 10 ma (0.010 amp) the shock is severe enough to paralyze muscles so that the man is unable to let go the conductor.
3. At about 100 ma (0.100 amp) the shock is fatal if it lasts for 1 second or more.

It is important to remember that current, instead of the quantitative value of the voltage, is the shock factor. About 50 percent of shipboard electrocutions are caused by circuits of 115 volts or less.

Two conditions must be met for current to flow through a man: He must form part of a closed circuit through which current can flow, and somewhere in the closed circuit there must be a voltage to cause current to flow. If the difference of potential (voltage) is small between the two conductors touched by the man, or if his body resistance is high, or if both these conditions are met, the current through his body may be small enough that he will not be fatally shocked, and may, indeed, be so small that he does not feel any shock at all.

If the two points of contact with the conductors at different potentials are on the same arm or the same leg, or are otherwise located so that the current path between them does not go through any vital organs of the man, he perhaps may not be fatally shocked even if the current is great enough to kill him if it followed a different path.

If, on the other hand, the potential difference between the points of contact is high enough (and 115 volts is more than high enough) and the body resistance is low enough, and if the current path goes through some of the man's vital organs, he will be fatally shocked.

The application to safety is obvious. A man should see to it that his body never forms part of a closed circuit through which current can flow. Unfortunately, as a man's ability with equipment increases, an increasing disregard often develops for the dangers inherent in high voltages. Electronic equipment enforces a stern safety code, thus violators are likely to be executed on the spot. High-voltage warning signs are posted prominently on and near electronic equipment, and they must be obeyed.

Deenergizing Circuits

Before any maintenance operations are started, circuits must be deenergized to enable work to be done safely. The best method of deenergizing, of course, is to turn off the main power source. Some equipments, however, have heater circuits and synchro voltages that are on another line than the main power source, and these also must be turned off. After securing main power supply and cutout switches in each circuit from which power can be fed, each switch is tagged with a red tag-out card. The card is a warning to others that work is in progress and that only the man who opened the switch is allowed to close it and remove the tag. When more than one group of personnel is working on a circuit, each group places a tag on the switch; each group removes only its own tag when the work is completed.

Dangerous voltages may exist at capacitor terminals even after equipment is deenergized. Each space containing electronic equipment should be equipped with shorting bars to dissipate the residual charge and remove the dangerous voltages. The same procedure applies for tubes having caps with connecting wires.

When repair work, of an emergency nature, or servicing considered essential by the commanding officer, is undertaken on an energized circuit, the procedures described in chapters 60 and 67 (when revised or rewritten, chapters 9600 and 9670) of the Bureau of Ships Technical Manual are mandatory. No one is permitted to work on a live circuit unless a man is stationed to deenergize the circuit immediately in case of emergency. Further, a man qualified to render first aid for electric shock stands by during the entire period repairs are being made.

Handling Cathode Ray Tubes

Certain hazards pertain to handling the relatively small cathode ray tubes in teletypewriter converters and test equipments.

The tubes should be handled only with heavy gloves. Safety goggles must be worn to protect eyes from flying glass in the event of envelope fracture, which might cause implosion owing to high vacuum within the tube. Recommended goggles provide side and front protection and have clear lenses that withstand a fairly rigid impact test. No part of the worker's body is to be directly exposed to possible glass splinters caused by implosion of the tube. The inside fluorescent

coating on some tubes is poisonous if absorbed into the bloodstream.

The tube is removed from its packing box with caution, care being taken to avoid striking or scratching the envelope. The tube is inserted into the equipment socket cautiously, using only moderate pressure. (This precaution also applies when removing tube from equipment socket.) The neck of the tube is made of thin glass. If the tube should break, particles from the neck may scatter with enough force to cause severe injury.

Cleaning Equipment

Cleaning electronic equipment may seem to be a routine housekeeping chore, but during the cleaning operation certain precautions are necessary to protect the equipment as well as the worker.

Power switches must be turned off, and the capacitors grounded with the shorting bar before the operation begins.

A vacuum cleaner with a nonmetallic hose is safe and useful but does not reach all the areas where dust accumulates. The preferred method of cleaning inside electronic equipment is with a brush such as a typewriter cleaning brush, together with the vacuum cleaner to remove the dirt as it is loosened by the brush.

Compressed air may be used to blow dirt from the equipment. A hand bellows is safest. Compressed air lines are available aboard ship but are not recommended for cleaning radio equipment because the air pressure is high enough to cause physical damage to delicate electronic parts. Besides, such air usually has a high moisture content. Attempts to blow dirt from radio equipment with compressed air may do more harm than good. The air may blow the dirt from the surface into inaccessible spaces, making the cleaning job more difficult.

Steel wool or emery paper are never utilized inside an equipment. Tiny particles of these conducting materials may cause dangerous short circuits.

Solvents are not used for cleaning unless absolutely necessary. Some solvents are flammable, others are toxic, and still others are both flammable and toxic. Besides these hazards, all solvents are somewhat harmful to electronic equipment. They dissolve waxes and compounds used to protect the equipment from fungus growth. They soften most types of insulation and cause it to become saturated with the

very dirt the user is trying to remove. The commonly available chlorinated solvents combine chemically with wax and oil to produce enough hydrochloric acid to etch metal surfaces, causing such troubles as erratic operation of switch contacts. A flammable solvent, such as alcohol, must never be used on energized equipments or near any energized equipment from which a spark may be received.

If a solvent must be resorted to, the user must observe the usual precautions regarding adequate ventilation, prolonged inhalation of the vapor, and repeated or prolonged contact of the solvent with the skin.

Working Aloft

No one is allowed aloft to work on antennas without first obtaining permission from the CWO and the OOD. Upon completion of the work, both officers are notified again.

When a man is going aloft, he should use only properly grounded ladders. All antennas in the vicinity should be isolated from the transmitters and grounded. A small spark, which of itself may be insufficient to cause harm, may result in death by causing a man to relax his grip involuntarily and plunge to the deck below. Ensure that every man working aloft wears a tested safety belt.

Before a man goes aloft, the various transmitters should be deenergized and their power switches tagged open. Failure to tag switches properly may result in injury if another man throws the switch.

While in port, the potential danger to personnel working aloft must be considered, because of transmissions from antennas of ships alongside. A mutually acceptable period is agreed upon before work is performed.

Radiation Hazards

Biological hazards resulting from high-energy radiation fields are discussed in chapter 7.

MOBILE UNIT

At various U. S. naval bases throughout the world, small groups of civilian electronics engineers and Navy enlisted technicians are maintained to assist in training shipboard repair personnel. These groups, called mobile

technical units, are designated by number (e.g., MOTU 6, MOTU 3).

Training is one of the primary missions of the MOTU. On many occasions a ship experiences casualties which the assigned technicians are unable to repair. In some instances, this inability is due more to inexperience of the men than to the complexity of the derangement. Upon request of the ship, the MOTU assigns a civilian engineer to assist the ship's force in training and repair.

The engineers do not do the work or attempt to effect repairs in the absence of shipboard personnel. Rather, they help the ship's force to analyze the difficulty and direct the repair force in the light of their greater experience. When the casualty is eliminated, the ship's personnel will have learned the proper technique of troubleshooting and should be able to handle the situation without assistance in the event of another similar difficulty.

MAINTENANCE RECORDS AND PUBLICATIONS

Important elements of the preventive maintenance program are the ship's material histories and the Current Ship's Maintenance Project (CSMP). Efficient administration requires, among other things, an exact knowledge of the current operating status of all electronic equipment and systems. In maintaining equipment material histories and the CSMP, the electronics material officer utilizes the following forms:

NavShips 529, Repair Record;
NavShips 530, Alteration Record;
NavShips 531, Resistance Test Record;
NavShips 536, Electronic Equipment History Card;
NavShips 537, Record of Field Changes.

MATERIAL HISTORY

The material history is a record of all repairs, alterations, inspections, derangements, measurements taken, parts renewed, nameplate data, length of time units were used, and other pertinent information on each item of equipment. An item's material history consists of the electronic equipment history card and the resistance test record.

The equipment history card, because it furnishes a complete picture of the past history of an equipment, is an aid in troubleshooting, correcting repetitive failures, and indicating the general reliability of the unit. A history card is prepared for each equipment, filled out initially by the electronics material officer, kept up to date, and remains with the equipment throughout its normal service life. Additional cards are made out for each major unit of the equipment to which the basic card pertains; these are filed alphabetically behind the basic card in a looseleaf material history binder.

A resistance test record, NavShips 531 (commonly called a megger card), is for the purpose of recording the insulation resistance of units and circuits such as radio antennas and power distribution circuits. Any significant drop in resistance indicates that repairs are needed. The megger card normally is inserted in the material history binder adjacent to the applicable equipment history card.

THE CSMP

The three remaining forms, Navships 529 (blue), 530 (pink), and 537 (white), constitute the Current Ship's Maintenance Project. The CSMP is, in effect, a record of repairs, alterations, and field changes remaining to be accomplished. As a repair is required, an alteration approved, or a field change authorized, the applicable card is filled out and filed in the material history binder behind the appropriate history card. Being of distinctive colors, the cards readily indicate the type of work outstanding. When preparing the cards, an important consideration is the adequate description of work to be accomplished.

The repair records for work that is beyond the capacity of the ship's force, for example, should contain the information that will be needed later for the repair requests for shipyard or tender work. Entering complete data at the time the need for repair becomes evident will do much to guarantee successful shipyard and tender availabilities.

The record of field changes, which remains with the equipment throughout its service life, is extremely important. Without needed modifications, an equipment may become operationally obsolescent or subject to numerous failures. Lacking a record of field changes, it is difficult to determine what modifications, if any, were made. The information recorded on the record of field changes is essential for

routine maintenance, troubleshooting, and ordering parts for the improved equipment.

MAINTENANCE PUBLICATIONS

A number of other publications are also important to the maintenance program. These include the equipment technical manuals furnished by manufacturers, the BuShips Technical Manual, BuShips Journal, Electronics Installation and Maintenance Book (EIMB), and the Electronics Information Bulletin (EIB).

BuShips Technical Manual

The BuShips Technical Manual contains 90-odd chapters of instructions and data for the maintenance and repair of equipment and machinery that come under the cognizance of the Bureau of Ships. These instructions indicate what the Bureau considers the best engineering practice for the operation, maintenance, testing, and safety of the equipment and for the safety of personnel concerned with the equipment.

BuShips Journal

The Bureau of Ships Journal, published monthly, contains articles on new developments in ship operation, construction, and engineering. It has sections on ship maintenance, electronics, and shop notes.

The EIMB

The EIMB consists of a series of authoritative publications that provide data to field activities on the installation and maintenance of electronic equipment. Information in the EIMB is supplementary to equipment technical manuals and related publications, and is intended to reduce time-consuming research.

The informational content in the EIMB is divided into three categories: (1) general procedures that apply to all classes of equipment; (2) articles on particular classes of equipment, i. e., communication, radar, sonar, and related fields; and (3) information that relates to specific equipments.

The EIB

The EIB is a biweekly publication containing advance announcements on changes to be made

in the field, installation techniques, maintenance notes, beneficial suggestions, and technical manual distribution. Articles of lasting interest later are transcribed into the EIMB, except for field changes and corrections to other publications, which subsequently are reproduced and stocked at the Naval Supply Depot, Philadelphia.

Issues of the EIB are made available to all civilian and military personnel concerned with installation, operation, maintenance, and repair of electronic equipment. It is especially important that they be read by all electronics technicians, sonarmen, and operators.

PERIODIC REPORTS

An efficient reporting system, sensitive to failure or replacement trends of parts and equipments, is required to provide feedback information needed to measure and improve equipment reliability and maintainability.

By means of BuShips instructions and the biweekly EIBs, the Bureau of Ships specifies certain electronic equipment for which periodic reports must be submitted.

Electronic Performance and Operational Report

To evaluate the characteristics and usefulness of selected newly installed or modified equipments, BuShips requires the monthly submission of an electronic performance and operational report. (See fig. 14-1.)

For most of the chosen equipments, reporting begins with the first operating month after installation or medication, continuing monthly for 1 year. A special report is submitted when an equipment failure is noted in a casualty report, when a hazard is believed to exist, or when it is considered that additional facts would be of interest to BuShips.

These reports contain firsthand data obtained under actual operating conditions. They are of great value to BuShips in determining whether the equipment meets design capabilities and operational requirements, evaluating installation adequacy, checking maintenance procedures and safety devices, verifying preliminary manufacturer's standards, and enforcing contractual warranties.

In the general remarks section of the reverse side of the report are indicated any pertinent facts not given elsewhere on the form.

Included are detailed information on any unusual difficulty encountered in operation; exceptional maintenance required; and suggestions for improvements in design, tests, and new applications. A list of possible problem areas is shown on the form for convenience, but comments need not be limited to these areas.

Electronic Failure Reporting System

The electronic failure reporting system is established to collect failure data for the purpose of improving the performance, reliability, and ease of maintenance of electronic parts, assemblies, and equipments; and to facilitate improved support capabilities for items indicating abnormal failure rates.

The failure reporting system utilizes two reporting forms: (1) an electronic equipment failure/replacement report, and (2) an electronic equipment operational time log. These reports serve several excellent purposes:

1. They provide BuShips with a comprehensive presentation of the overall performance of selected material.
2. They point out the weakest circuit components of a particular equipment.
3. They are useful for calculating load lists and repair parts requirements.
4. Because new models (or modifications of existing models) usually are in some stage of development, prompt receipt of failure reports enables the Bureau to initiate corrective action to eliminate similar or related deficiencies in subsequent production.

The success of the reporting program, of course, depends on the basic data being presented accurately and rapidly by the personnel operating and maintaining the equipment.

FAILURE/REPLACEMENT REPORT. — The failure/replacement report (fig. 14-2) is designed so that, in most instances, all information relating to one equipment mishap can be entered on the same form.

Reported failures are tabulated in BuShips, and regular summaries are made to show the number and types of failures of any part of any equipment. The summaries are forwarded to the cognizant design and maintenance engineers in the Bureau of Ships and to the equipment contractor for evaluation and corrective measures. From the reported data a determination may be made of the field changes required to make the equipment perform reliably. The in-

formation also shows the point of diminishing return at which it is more economical to replace an equipment than to keep the old one in operation.

Responsible officers must realize the importance of reporting electronic failures and their causes, particularly the circumstances existing when failures occur under actual operating conditions. The reports must be filled in completely and in conformity with the instructions accompanying the forms. Reports received by the Bureau of Ships are valueless if they do not provide the essential information required by the form or if the information given is incomplete.

OPERATIONAL TIME LOG. — The electronic equipment operational time log serves two purposes. First, it accumulates information for BuShips concerning the reliability of a selected part or system, its maintenance problems, and failure/replacement rate calculations. Second, it keeps the Bureau informed concerning the number of selected equipments that are operationally in use. At the operating level, it can be helpful in the preparation of both the failure/replacement report and the performance and operational report. Each sheet of the log covers one calendar month, as indicated in figure 14-3. Instructions for completing the log accompany the forms.

PLANNED MAINTENANCE PROGRAMS

The U. S. Navy makes every effort to provide properly designed electronic material and to support this material with adequately trained personnel. Because of broad limitations, however, this is not always possible. It is mandatory, therefore, that each organizational element plan on using efficiently its existing material with a minimum of outside assistance. Ships must be as self-sufficient as possible. Reliance on expected new equipment or receipt of special experts to improve a unit's readiness is unsound. Lack of a specific electronic equipment or of a specially trained officer or enlisted man is no valid reason for not using available equipment efficiently.

The Bureau of Ships has cognizance over all electronic equipment used in the fields of detection and tracking, recognition and identification, communications, and electronic warfare, including all testing and measuring devices. In furtherance of what was said in the

Chapter 14—MAINTENANCE

ELECTRONIC PERFORMANCE & OPERATIONAL REPORT NAVSHIPS 3878 (Rev. 4-60) Submit original only to Bureau - No forwarding letter required								REPORT-NUSHIPS-0470-1		
FROM: USS RANGER (CVA-61) <small>(Ship name, type and hull no.)</small>				<input type="checkbox"/> LANT <input checked="" type="checkbox"/> FLEET <input checked="" type="checkbox"/> PAC	REPORT CLASSIFICATION UNCLASSIFIED		DATE <u>1 Sep</u>			
TO: CHIEF, BUREAU OF SHIPS (CODE)				REPORTING PERIOD FROM <u>1 Aug</u> - TO <u>31 Aug</u>						
TYPE AND MODEL OF EQUIPMENT AM-1365/URT Amplifier				SERIAL NUMBER <u>383</u>						
FIELD CHANGES TO DATE None		ACCOMPLISHED None		NOT ACCOMPLISHED None		HOURS DURING PERIOD OF THIS REPORT OPEN-ED 180 NOT IN OPERATING CONDITION 564				
PERFORMANCE FIGURE (PF) & TECHNICAL EVALUATION <input type="checkbox"/> OUT-STANDING <input type="checkbox"/> GOOD <input type="checkbox"/> SATIS-FAC-TORY <input checked="" type="checkbox"/> UNSATIS-FAC-TORY				OPERATIONAL EVALUATION <input type="checkbox"/> OUT-STANDING <input type="checkbox"/> GOOD <input type="checkbox"/> SATIS-FAC-TORY <input checked="" type="checkbox"/> UNSATIS-FAC-TORY						
PEAK POWER OUTPUT (PT) <small>dBm</small>				AVER. VSWR IN TRANSMISSION LINE <small>YDS</small>		AVER. ECHO BOX RING TIME <small>YDS</small>				
<small>MAX. RANGE TARGETS DETECTED</small> <small>MI</small>		<small>MI</small>		<small>MI</small>		<small>MAX. ALTITUDE AT RANGE DETECTED</small> <small>MI</small>				
<small>MAX. ALTITUDE TARGETS DETECTED</small> <small>FT</small>		<small>FT</small>		<small>FT</small>		<small>RANGE AT MAX. ALTITUDE DETECTED</small> <small>FT</small>				
<small>TARGET CLASS. TYPE - DETAIL (SEE REVERSE)</small>						<small>TARGET CLASS. TYPE - DETAIL (SEE REVERSE)</small>				
<small>MAXIMUM RELIABLE RADAR RANGE</small> <small>MI</small>						<small>MINIMUM RELIABLE RADAR RANGE</small> <small>YDS</small>				
<small>SOURCE LEVEL (LS) db//UBAR</small>		<small>RECEIVING SENSITIVITY db//VOLT/UBAR</small>		<small>SEA STATE</small>		<small>PROCEDURE USED</small>				
<small>NOISE LEVEL db//VOLT</small>		<small>5 KNOTS</small>		<small>10 KNOTS</small>		<small>15 KNOTS</small>		<small>20 KNOTS</small>	<small>25 KNOTS</small>	<small>30 KNOTS</small>
<small>MAXIMUM RANGE SONAR TARGETS DETECTED AND TRACKED</small>				<small>RANGING</small> <small>YDS</small>				<small>LISTENING</small> <small>YDS</small>		
<small>TARGET CLASSIFICATION TYPE AND DETAIL</small>									<small>SOUNDING</small> <small>FATHOMS</small>	
<small>BT PATTERN</small>										
<small>OWN SHIP'S SPEED.</small>				<small>KTS</small>		<small>KTS</small>			<small>KTS</small>	
<small>PERCENT OF TIME OUT OF CONTACT WHILE WITHIN RANGE (IF ANY)</small> <small>0 %</small>		<small>ANTENNA SYSTEMS</small>		<small>INTERFERENCE (Frequencies, Intensity, and sources)</small> <small>No problems</small>						
<small>POWER OUTPUT</small> <small>Voice 100 WATTS</small>		<small>AVERAGE VSWR</small> <small>1.5:1</small>		<small>REL RANGE</small> <small>40 miles</small>		<small>RECEIVER SENSITIVITY</small> <small>NA</small>		<small>UVOLTS</small>		
<small>MAXIMUM RANGE AND ALTITUDE TARGETS NOT FILTERED</small> <small>TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)</small>		<small>MI</small>		<small>FT</small>		<small>MI</small>		<small>FT</small>		
<small>MAXIMUM RELIABLE RANGE AND ALTITUDE</small> <small>TARGET CLASSIFICATION TYPE AND DETAIL (SEE REVERSE SIDE)</small>		<small>MI</small>		<small>FT</small>		<small>MI</small>		<small>FT</small>		
<small>MAX. RANGE SONAR TARGETS DETECTED</small> <small>YDS</small>		<small>BT PATTERN</small>				<small>MAX. RELIABLE SONAR RANGE</small> <small>YDS</small>		<small>BT PATTERN</small>		

35.83.1

Figure 14-1.—Electronic performance and operational report.

NAVAL COMMUNICATIONS

TARGET CLASSIFICATION

TYPE	DETAIL
1. Large Plane (Bomber)	a. Own Ship's controlled aircraft
2. Small Plane (Jet Fighter)	b. An alerted aircraft approach or contact (An aircraft whose existence and location is known prior to being picked up on own radar)
3. Group of Planes	c. An unalerted aircraft approach or contact (An aircraft whose existence was not previously known)
4. Merchant Ship	d. An opening aircraft contact
5. Warship	e. An anticipated surface contact
6. Formation of Ships	f. An unanticipated surface contact
7. Submarine	g. Snorkeling
8. Buoy	h. Submerged
9. Weather Front	i. Other (Explain)
10. Land	j. Unknown
11. Other (Explain)	
12. Unknown	

OUTAGE REMARKS: (Account for time equipment was NOT in operating condition. Show casualty, corrective action, outage time and comments. Include time inoperative for preventive maintenance and POMSEE. Reference Casualty Report, if one submitted on this equipment during this reporting period.)

Equipment was in use for about 180 hours when C8, P.A. plate feed through capacitor, shorted, causing overload relay to kick out. Repair part not available on board, was ordered and not yet received. Three failures of this type have occurred among the eight units installed.

GENERAL REMARKS: (Comment on any problems or inadequacies encountered in the equipment. Comment is also desired on any item above or any item not covered by this report. When detailed tracking data is available and the equipment can be evaluated operationally, comment on such items as reliability, target discrimination and clarity. If overheating occurs report ambient and equipment temperature in degree. If equipment is considered to be operating satisfactorily, so state.) (Problem areas listed below are for convenience.)

Antenna
Cabling (including wave guides)
Design
Electrical
Interference
Lubrication
Maintenance
Mechanical
Overheating
Power input
Physical operation
Safety devices
Spare parts
Test equipment
Test points
Transducer
Tube failures
Vibration
Logistic support (Manuals, repair activities, over-haul, etc.)

While equipment was operating properly, 40 mile range was consistent.

The failure of C8 is considered a design problem.

Experience to date has indicated that the AM-1365/URT is saving the 4X150A output tubes in the TED-8 transmitter. Longer tube life is gained through reduced drive required from the TED-8. Ten watts output is sufficient, compared with the attempt to drive the transmitter at 30 watts before the AM-1365/URT amplifier was installed.

C. O. Holt
SIGNATURE
C. O. HOLT, CDR USN By direction

CLASSIFICATION (of this report)
UNCLASSIFIED

6-43887

35.83.2

Figure 14-1.—Electronic performance and operational report—Continued.

ELECTRONIC EQUIPMENT FAILURE/REPLACEMENT REPORT DD-787 (PROPOSED)								REPORT BUSHIPS 10550-1																											
1. DESIGNATION OF SHIP OR STATION CVA(N)-65				3. TYPE OF REPORT (CHECK ONE)				4. TIME FAIL. OCCURRED OR MAINT. BEGAN																											
2. REPAIRED OR REPORTED BY NAME: R.E. LEE RATE: RMC AFFILIATION: 1 <input checked="" type="checkbox"/> U.S. NAVY 2 <input type="checkbox"/> CONTRACTOR 3 <input type="checkbox"/> CIVIL SERVICE				<input checked="" type="checkbox"/> OPERATIONAL FAILURE <input type="checkbox"/> PREVENTIVE MAINTENANCE (POMSEE) <input type="checkbox"/> PREVENTIVE MAINTENANCE (NOT POMSEE)				<input type="checkbox"/> STOCK DEFECTIVE <input type="checkbox"/> REPAIR OF REUSABLE UNIT OR PLUG-IN ASSEMBLY <input type="checkbox"/> OTHER				MONTH: 3	DAY: 3	YEAR: 6	TIME: 1200																				
6. MODEL TYPE DESIGNATION AN/URC-32				9. FIRST INDICATION OF TROUBLE (CHECK ONE)				5. TIME FAIL. CLEARED OR MAINT. COMPL.																											
7. EQUIP. SERIAL NO. 23		8. CONTRACTOR (NAVY CODE OR COMPLETE NAME) COL		<input checked="" type="checkbox"/> INOPERATIVE <input type="checkbox"/> OUT OF TOLERANCE, LOW <input type="checkbox"/> OUT OF TOLERANCE, HIGH <input type="checkbox"/> INTERMITTENT OPERATION				<input type="checkbox"/> UNSTABLE OPERATION <input type="checkbox"/> NOISE OR VIBRATION <input type="checkbox"/> OVERHEATING <input type="checkbox"/> VISUAL DEFECT <input type="checkbox"/> OTHER, EXPLAIN				MONTH: 3	DAY: 3	YEAR: 6	TIME: 1225																				
10. OPERATIONAL CONDITION (CHECK ONE)								11. TIME METER READING																											
<input checked="" type="checkbox"/> OUT OF SERVICE <input type="checkbox"/> OPERATING AT REDUCED CAPABILITY <input type="checkbox"/> UNAFFECTED								A. HIGH VOLTAGE <input type="checkbox"/> NONE B. FILAMENT /ELAPSED <input type="checkbox"/> NONE																											
12. REPAIR TIME								13. REPLACEMENT DATA																											
14. LOWEST DES. U.S.A. SERIAL NO. 17								15. REFERENCE DESIGNATION (V-101, C-14, RII, ETC.) N/A				16. FEDERAL STOCK NUMBER F5820-672-6313				17. MFR. OF REMOVED ITEM COL				18. TYPE OF FAILURE 255				19. PRIMARY OR SECONDARY FAIL? P <input checked="" type="checkbox"/> S <input type="checkbox"/>				20. CAUSE OF FAILURE 8 T				21. DISPOSITION OF REMOVED ITEM Y <input checked="" type="checkbox"/> N <input type="checkbox"/>			
22. REPLACEMENT AVAILABLE LOCALLY? Y <input type="checkbox"/> N <input checked="" type="checkbox"/>																																			
23. REPAIR TIME FACTORS								24. REMARKS (CONTINUE ON REVERSE SIDE IF NECESSARY)																											
CODE	DAYS	HOURS	TENTHS	CODE	DAYS	HOURS	TENTHS																												

15.2

Figure 14-2. — Electronic equipment failure/replacement report.

first paragraph of this chapter ("...because it is essential that none of the features of shipboard maintenance be overlooked or neglected, a continuing maintenance program is needed..."), BuShips currently has two official maintenance programs in effect.

Performance, Operation, and Maintenance Standards for Electronic Equipment (POMSEE) is the basis for a recommended preventive maintenance program for electronic equipment under the technical control of the Bureau.

The shipboard Planned Maintenance System (PMS) is a mandatory management tool designed to plan, schedule, and control the performance of routine preventive maintenance on all equipment.

POMSEE PROGRAM

Under the POMSEE program, performance standards sheets provide the operational performance data and basic technical measure-

ments indicative of the minimum acceptable level of performance for the electronic equipments.

The performance standards sheets provide a single standard for each equipment type, furnishing both a technical and nontechnical description of the expected equipment performance. This standard must be met by all ship installations of a particular model.

Procedures for obtaining the maintenance standards test indications are given in a series of charts. Each chart or group of charts covers a functional section of the entire system. An accompanying illustration page shows the equipment setup pertaining to each of the procedural steps on the chart. The illustration page bears encircled numbers corresponding to the steps of procedure of the chart to which it applies.

Using an illustration page along with its associated chart makes a relatively simple task of determining the reading or performing the required check. The comparison of a current reading with readings previously recorded re-

NAVAL COMMUNICATIONS

ELECTRONIC EQUIPMENT OPERATIONAL TIME LOG NAVSHIPS 4855				
SUBMIT MONTHLY FOR EACH APPLICABLE EQUIPMENT WHETHER IN USE OR NOT IN USE				
1. MONTH	YEAR	2. DESIGNATION OF SHIP OR STATION		
12	64	CVA(N)-65		
3. EQUIPMENT MODEL TYPE DESIGNATION			4. EQUIP. SERIAL NO	
AN/SRT-14			21	
COMPLETE THIS SECTION IF EQUIPMENT HAS TIME METER(S)				
READ DATA ON COVER	5. FILAMENT OR ELAPSED TIME METER READINGS	6. LEAVE BLANK	7. HIGH VOLTAGE (PLATE) TIME METER READINGS	8. LEAVE BLANK
	1st DAY OF MO LAST DAY OF MO		1st DAY OF MO LAST DAY OF MO	
	4765.3 5465.7		1234.5 1345.6	9. NO OF OPERATIONAL FAILURES THIS MO. 3
COMPLETE THIS SECTION IF EQUIPMENT DOES NOT HAVE TIME METER(S)				
10. DAY OF MONTH	II. STANDBY	12. LEAVE BLANK	13. FULLY ENERGIZED	14. LEAVE BLANK
	TIME ON TIME OFF		TIME ON TIME OFF	
DO NOT WRITE BELOW THIS LINE - CONTINUE ON REVERSE SIDE IF NECESSARY				

Figure 14-3. — Electronic equipment operational time log.

15.3

veals any significant change. Slight changes, which occur frequently, are no cause for alarm. When a particular step of procedure results in a reading that varies progressively in the same direction, however, it is an indication of improper operation or of reduced performance.

Although the POMSEE program may be phased out when a ship changes over to the PMS program, the charts, illustrations, and performance standards sheets may be of value for reference purposes so long as the applicable equipment does not become obsolete.

PLANNED MAINTENANCE SYSTEM

A Navy planned maintenance system (PMS) is being installed throughout the operating fleet

as the result of an OpNav instruction (4700.16) issued in 1963. Within the next few years, the PMS will be standard in all departments on all active ships.

For several reasons, previous maintenance programs and efforts fell short of desired goals. To eliminate the problem areas, the PMS defines and schedules the preventive maintenance required for all shipboard equipment, even down to the methods and tools to be used and the time and rate required to accomplish each task.

The objective of the PMS is to prescribe a standard, uncomplicated system of planning and control to provide for the uniform accomplishment of preventive maintenance aboard ships. This in turn will enable achievement of the highest possible state of material readiness with the resources available.

Organization

Personnel are organized into maintenance groups, patterned after the standard shipboard organization, which are assigned responsibility for maintaining specific equipment. Each maintenance group is under a maintenance group supervisor, who is the petty officer in charge of that group.

It is desirable, wherever possible, that personnel who operate equipment perform the required preventive maintenance. Where personnel from one department operate equipment under the cognizance of another, coordination between the two departments is necessary to ensure that all tasks are accomplished.

Tools of the System

In the PMS, emphasis is placed on advance planning instead of on the recording of mere historical maintenance facts. Planning is initiated by the type commander when he issues an overhaul cycle maintenance schedule. Based on this schedule, department heads prepare quarterly schedules. To carry the plan further, responsible petty officers/division officers break down the quarterly schedules into weekly maintenance actions.

Proper use of the scheduling devices ensures accomplishment of all preventive maintenance tasks, takes into consideration the ship's employment schedule and daily routine, provides interdepartmental coordination, and affords flexibility to allow schedule adjustments when the situation dictates. It is important that the schedule of maintenance tasks be planned at least one quarter in advance; this plan then may be adjusted on a monthly basis as contingencies demand.

The basic tools of the system consist of the following:

1. Overhaul cycle schedule (referred to simply as the cycle schedule).
2. Quarterly schedule.
3. Weekly schedule.
4. Departmental PMS manual.
5. Maintenance requirements cards (MRCs).

CYCLE SCHEDULE.—A cycle schedule is prepared for each maintenance group on the ship. This practice permits equalization of the group's workload throughout the overhaul cycle. The time frame of the schedule is the entire period between and through overhauls for the

class of ship concerned. It commences during the calendar quarter in which the ship completes overhaul (or in which the PMS is installed).

The schedule lists the components (e.g., receivers, transmitters) for which each maintenance group is responsible, and it shows, on a quarterly basis, all the preventive maintenance actions (except weekly and daily) required during the period between overhauls. All the maintenance items in the schedule are within the capability of the ship's force and equipment.

The department head uses the cycle schedule to prepare current and subsequent quarterly schedules. It is then posted on the department's maintenance control board, with the quarterly schedules, as part of the long-range maintenance schedule. Because the schedules are displayed visually, they are readily accessible to departmental division officers and maintenance group supervisors.

QUARTERLY SCHEDULES.—Taking into consideration the ship's quarterly operating schedule, the department head prepares the current and subsequent quarterly maintenance schedules, based on the requirements contained in the cycle schedule. He does this in conjunction with his division officers and maintenance group supervisors.

The information is transcribed from the cycle schedule to a specific week (in the quarterly schedule) during which the work is expected to be done. The quarterly schedule is arranged in weekly columns to permit flexibility in rescheduling to accommodate changes that may occur in the ship's operating schedule.

A quarterly schedule displays the entire maintenance workload for the quarter, and is a directive for maintenance group supervisors in scheduling their weekly maintenance. At the end of each week, the group supervisors cross out (with an X) all maintenance requirements that have been accomplished, and encircle those not accomplished; the latter must be rescheduled. At the end of each quarter, the current quarter schedule is removed from the display board to become the ship's record of preventive maintenance actions performed or not performed. The subsequent quarter schedule then becomes the current schedule, and a new subsequent quarter schedule is posted.

WEEKLY SCHEDULE.—Each maintenance group supervisor prepares weekly schedules from the information appearing on the quarterly schedule. Preprinted on the weekly schedules

are recurring daily and weekly maintenance actions that do not appear elsewhere.

The weekly schedule lists the components involved in the maintenance group area. It is used by the working area supervisor to assign work and record its completion.

The group supervisor assigns personnel, by name, to perform each required action on a specified day during the week. The schedule is posted in each maintenance group's working area.

The man assigned to work on a component is responsible for completing the required action on the day scheduled. After maintenance is completed, he marks the scheduled item with an X. If, for any reason, work cannot be accomplished during the week concerned, he circles the appropriate entry. At the end of the week, the group supervisor utilizes the X and O entries on the weekly schedule to bring the quarterly schedule up to date. He then cleans off the old weekly schedule (the form is made of plastic) and prepares a new one for the following week.

PMS MANUAL. — Each department of the ship (engineering, operations, weapons, and so on) utilizes its own planned maintenance system manual. It contains the minimum preventive maintenance requirements for every component or system installed for the department. The PMS manual normally is retained in the department office, and it is used mainly by the department head to plan and schedule maintenance.

Each page in the manual (fig. 14-4) covers a single component or equipment. (The pages are referred to as manual index pages.) On the page are given a short description of all maintenance requirements pertinent to the component, the frequency with which the maintenance actions occur (e.g., M—monthly, A—annually), the enlisted rates required to do the work (in other words, the minimum skills required), and the length of time normally needed to perform the operation. The letters and numerals in the left-hand columns are for BuShips control and identification purposes. The column headed "M.R. No." identifies the number of the maintenance to be accomplished.

MAINTENANCE REQUIREMENTS CARDS. — The maintenance requirements cards are the key to the success of the entire planned maintenance system aboard ship. The development process for the MRCs, which was a vital and critical phase in setting up the PMS, demanded

the best professional efforts of all the agencies concerned with the program.

For example, all sources of requirements for maintenance, such as bureau manuals, manufacturer's instruction books, fleet and type commanders' instructions, POMSEE manuals, and the like, had to be reviewed to sort out; tabulate, and evaluate the requirements. It was then necessary to examine these requirements critically to eliminate extraneous material but to ensure that no required action was overlooked.

To be of value, the MRCs on any ship must agree completely with the contents of the PMS manual as well as the equipments and systems actually on board. At the very least, this requirement necessitates a complete inventory of all equipment before the cards can be prepared. Once these cards are received on board, they supersede the requirements set forth in any technical publications (including the BuShips Technical Manual), so far as preventive maintenance is concerned.

As shown in figure 14-4, there is a separate MRC for each preventive maintenance action that must be taken on every system, subsystem, or component. The index page number, the card number, and a description of the required maintenance are entered on both the index page and the associated card. In figure 14-5, for example, the complete maintenance requirement numbers are C-1 A-1 and C-2 M-2. The designations C-1 and C-2 refer to the index page numbers of the PMS manual; A-1 and M-2 are the card numbers. Further, the letter C identifies each equipment as a "communications and control" component; the letters A and M indicate the periodicity of the maintenance action required.

The MRC provides detailed guidance for the individual performing a preventive maintenance task on a specific equipment. The complete operation is defined in sufficient detail to enable assigned personnel to perform the job without difficulty. In addition to the instructions regarding the maintenance task, the card lists information needed by supervisory and scheduling personnel (frequency of accomplishment, minimum skill level required, time to accomplish, and so on).

A complete working set of applicable MRCs, with a container, is installed in each maintenance group working area where they are available to those performing the maintenance tasks.

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System, Subsystem, or Component					Reference Publications and/or Maintenance Significant Number					
TED (series) Radio Transmitter										
Bureau Card Control No					Maintenance Requirement		M.R. No.	Rate Req'd	Man Hours	Related Maintenance
CK	041COTP2A3	AA71	M		1. Check power output and modulation of TED transmitter not used with AM/1365-URT.		M-1	RM3	0.4	
CK	041COTP2A3	AA72	M		1. Clean air filters.		M-2	RMSN	0.2	
CK	041COTP2A3	AA73	A		1. Clean interior of equipment.		A-1	RMSN	0.3	

System, Subsystem, or Component					Reference Publications and/or Maintenance Significant Number					
AN/URR-35A, 35B, 35C UHF Radio Receiver										
Bureau Card Control No					Maintenance Requirement		M.R. No.	Rate Req'd.	Man Hours	Related Maintenance
CK	030ARG2	A3	AA42	M	1. Measure sensitivity. 2. Check silencer circuit operation. 3. Measure noise limiter loss. 4. Check blower operation.		M-1	RM3	0.8	
CK	030ARG2	A3	AA69	M	1. Clean air filters.		M-2	RMSN	0.1	
CK	030ARG2	A3	AA70	A	1. Clean interior of equipment.		A-1	RMSN	0.2	

105.21

Figure 14-4.—PMS manual index pages.

A master deck of all cards for each department is retained in the department office with the PMS manual. If a card is lost, soiled, or torn, it is replaced by typing a duplicate card from the master deck.

DATA COLLECTION SYSTEM

For the planned maintenance system to be successful, there must be an adequate method that will enable commanders and the technical bureaus to carry out their management functions in support of the program. Accordingly, a maintenance data collection (MDC) system for gathering, processing, analyzing, and distributing feedback information was implemented in parallel with the PMS. Currently, the MDC system is being tested and evaluated through the efforts of the Maintenance and Material Management Project Center (MMMP). The Center is under the direct control of the Chief of Naval Operations.

The shipboard test plan (aircraft squadrons are included in the total project effort) utilizes the destroyer ship class. The test involves designated destroyer squadrons and tender repair departments reporting on equipment maintenance. Data generated in individual ships are key-punched, edited, and forwarded to an electronic data processing facility in the tender, where they are machine-processed to produce the required management reports. The MMMP provides mobile training teams to the selected ships to train personnel in the mechanics of implementing the system.

Commencing about mid-1964, it is planned to introduce the data collection system to the fleet on a progressive basis. It is expected to include all surface force activities by January 1966.

ACCOMPLISHMENT OF REPAIRS

An availability is the period of time assigned a ship for the uninterrupted accomplishment of work at a repair activity. Repair availabilities may be classified as restricted, technical, interim overhaul, regular overhaul, voyage repair, and upkeep period.

A restricted availability accomplishes specific items of work, normally with the ship present. This availability is assigned to many of the ships that go alongside a repair ship or tender.

A technical availability accomplishes specific items of work, normally with the ship not present. This type of availability may be assigned when a unit of auxiliary equipment needs repair; the unit may be left at the repair activity while the ship continues on its mission. Arrangements must be made for the ship to deliver the defective units and either call for them on completion of repairs or provide shipping instructions.

An interim overhaul availability accomplishes general repairs and alterations at a shipyard or other shore-based repair activity. Many ships are assigned interim availabilities about midway between the regular overhauls. The length of an interim availability may not exceed more than one-half the duration of a regular overhaul.

Ships are assigned regular overhaul availabilities at naval shipyards or other shore-based repair activities in accordance with an established time cycle. In general, a major overhaul is scheduled for a 3-month period about every 2 years. The period assigned may vary somewhat, depending on the type of ship and whether extensive alterations are planned. Ships are notified of the assigned period by means of the type commander's annual employment schedule, which is promulgated to all ships under his command.

A voyage repair is an availability for emergency work necessary to enable a ship to continue on its mission. Voyage repairs can be accomplished without requiring a change in the ship's operating schedule.

An upkeep period is assigned to a ship for the accomplishment of work by the ship's force or other forces afloat. Whether the ship is moored alongside a tender or repair ship depends on whether the work to be done is within or beyond the capacity of the ship's force. Regularly scheduled upkeep periods are a normal part of the ship's maintenance cycle. Their purpose is to keep the ship in condition during intervals between regular overhauls.

REGULAR OVERHAUL

Of the types of availability listed, the regular overhaul is by far the one of greatest importance. It also requires the most preparation in advance. Although the procedures covered in this section may apply in some degree to

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SYSTEM		COMPONENT		M. R. NUMBER		M. R. NUMBER	
Communications and Control		AN/URR 35A, 35B, & 35C		C-1		A-1	
SUB-SYSTEM		CARD OF		CARD OF		CARD OF	
Radio Communication Systems		RELATED M. R.		RELATED M. R.		RELATED M. R.	
MAINTENANCE REQUIREMENT DESCRIPTION		RATES		RATES		RATES	
1. Clean interior of equipment.		RMSN		RMSN		RMSN	
		TOTAL M/H		TOTAL M/H		TOTAL M/H	
		0.2		0.2		0.2	
		ELAPSED TIME		ELAPSED TIME		ELAPSED TIME	
		0.2		0.2		0.2	
MAINTENANCE REQUIREMENT DESCRIPTION							
1. Clean air filters.							
TOOLS, PARTS, MATERIALS, TEST EQUIPMENT							
1. Vacuum cleaner							
2. Shorting bar							
PROCEDURE							
NOTE: Air filter is located on rear of RF chassis.							
1. Clear air filters:							
a. Secure all power to the equipment.							
b. Loosen the captive wing nuts on the front panel.							
c. Withdraw the unit from the cabinet to its normal stops.							
d. Discharge all capacitors with the shorting bar.							
e. Release the fasteners on the air filter frame and remove air filter.							
f. Vacuum the filter causing the air to reverse flow through the filter.							
g. Reinstall the filter in the equipment if cleaning by this method is satisfactory; if not, proceed with the following steps.							
h. Wash the filter in warm water and detergent and rinse in warm water.							
i. Blow excess moisture from the filter with low pressure air or shake out, whichever is desirable.							
j. Allow filter to dry thoroughly, then reinstall.							
k. Replace and secure chassis in cabinet.							
l. Return equipment to normal operation.							
PROCEDURE							
1. Clean interior of equipment:							
a. Secure all power to the equipment.							
b. Loosen fastening devices on the front panel and pull the receiver out on its slides to the stops.							
c. Discharge all capacitors with a shorting bar.							
d. Remove dirt from the "hard to get to" areas with a soft bristle brush.							
e. Wipe out the inside of the cabinet with a clean rag.							
f. Remove remaining dirt from the chassis with a vacuum cleaner.							
g. Replace and secure the chassis in the cabinet.							
h. Return equipment to normal operation.							
MAINTENANCE REQUIREMENTS CARD							
OPMAN FORM 4700-1 (REV. 1-64)							
C-36470							
MAINTENANCE REQUIREMENTS CARD							
OPMAN FORM 4700-1 (REV. 1-64)							

Figure 14-5.—The MRC provides detailed guidance for the individual performing a preventive maintenance task on a specific equipment.

other (or all) availabilities, the discussion is aimed mainly at the regular overhaul.

Work Requests and Job Orders

Preceding the assigned availability, all field changes that can be made by ship's personnel should have been made or plans made for their accomplishment during the overhaul. Equipment histories associated with the communication equipment should be evaluated, and all operational and maintenance logs and checklists reviewed for accuracy and completeness.

If the ship's CSMP and required reports are maintained properly, the work requests necessary to have repairs effected should be relatively simple to prepare. The repair items that can be accomplished only during overhaul are transcribed from the CSMP card onto a formal work request. Procedures for submitting the work requests are laid down in general in Navy Regulations, and in detail in fleet and type commander instructions.

Items of work are entered in the relative order of priority for each work list of the group (e.g., hull, engineering, ordnance) listed. After the work lists are complete, a ship's priority index is prepared. Usually the priority index is made up in a conference of all heads of departments and the executive officer. The various items are selected from the individual repair lists and are assigned in an overall order of priority for the ship.

In defining the work to be accomplished, specific descriptions must be included in the requests. Needed parts should be identified by stock numbers, blueprint numbers, nameplate data, and so on, to provide yard planners with sufficient information and time to order the parts and have them on hand before the ship's arrival.

Each work request lists the names of the ship's inspectors; normally, the cognizant officers and petty officers are designated. The ship's inspectors are qualified to discuss the details of the specific job with yard workmen and pass on the completeness of the repairs.

All work within the capacity of the ship's force must be done by ship's company. A schedule of communication work items should be prepared to include (1) names of persons responsible for accomplishment; (2) estimate date of completion; (3) estimated number of man-hours required; and (4) assistance required

from the yard in the form of materials or tools.

The communication officer is responsible for submitting a timely list of communication work items to the operations officer for approval and further routing to the repair officer (usually the engineer officer). The repair officer incorporates the list in the overall schedule of ship's force work to be submitted to the yard. A copy of the communication work list should be posted in a conspicuous place and the items checked off as each is completed.

SUPPLEMENTARY WORK REQUESTS.—In the period between submitting the original work lists and the ship's arrival at the shipyard, an unforeseen difficulty might necessitate shipyard repairs. In such a circumstance, an additional repair list, called the first supplement, is prepared and submitted before the ship's arrival at the yard.

The naval shipyard holds numerous tests and inspections of equipment in accordance with an established procedure and as requested by the ship. These tests and inspections may disclose additional needed repair items. When these initial tests and inspections are completed, a supplementary repair list is made out to cover defects that are found. This repair list is called the first or second supplement, as applicable.

Ordinarily, apart from the two instances mentioned, there should be no further need for submitting supplementary repair items. In other words, all items requiring shipyard repairs should be written up and submitted before a ship arrives in the yard—not after it has been in the yard for some period of time. In most instances, other last-minute jobs indicate that the ship's maintenance program is inadequate, that the CSMP recordkeeping is incomplete or not up to date, or that there is a lack of experience or knowledge in submitting a complete list of repair items for shipyard overhaul.

Arrival Conference

When the ship arrives in the shipyard for overhaul, an arrival conference is held. This conference is supervised by the shipyard planning officer, and is attended by representatives from the ship, type commander, shipyard, and other interested persons. The ship's work request list and individual item costs estimated

by the shipyard planning department are reviewed.

The limitation of the funds available (a limitation set by the type commander) determines the number of job orders or specifications issued for the accomplishment of repairs during the overhaul period.

Overhaul Progress Analysis

During a shipyard overhaul period, the ship may be required to submit weekly shipyard progress reports in compliance with the type commander's instructions. For these reports, ship's supervisory personnel must maintain an accurate check on the progress of work at all times. The progress analysis should include ship's force work and shipyard work. Any number of progress charts can be used, but usually one chart is kept for the shipyard work and another for ship's force work.

Inspection of work being done by a repair activity for a ship is the responsibility of both the repair activity and the ship. The repair activity makes those inspections that will ensure the proper execution of the work and adherence to prescribed specifications and methods. The ship makes any inspections that are necessary to determine if the work is satisfactory both during its progress and upon completion.

The communication officer should arrange his schedule in such a way that he is free of all times to inspect and check the progress of shipyard work going on in his spaces or being performed on equipment for which he has responsibility. A check should be made to see that any required tests are made by the shipyard before the job is considered fully completed.

Shipyards are required to hold frequent (usually weekly) conference. These are attended by the commanding officer and repair (engineer) officer of the ship and interested shipyard personnel such as the production officer, other shipyard department heads, the ship's superintendent, and master mechanics. The topics discussed at the conference customarily include jobs encountering delays or other difficulties, additional work required, the quality of work being done, and the availability of critical materials.

In checking on the progress of a job, responsible persons must have detailed informa-

tion of what repair work is to be accomplished. This information can be obtained from the job orders issued by the planning department of the yard. The ship receives three or more copies of these job orders; a copy of orders applicable to the communication division ordinarily is held by the communication officer.

STOCK REPLENISHMENT OF SPARE PARTS

The quantities and types of nonconsumable material (such as repair parts) that a ship may carry at any one time are limited by the ship's allowance list. The list is used as authority for procuring, replacing, and making alterations to allowed equipment. Ships normally are required to carry a full allowance but are not permitted to exceed the allowance except with the approval of the type commander or cognizant bureau.

The necessity for a ship to maintain sufficient stocks to meet its requirements is obvious. Also important, but less obvious, is the necessity to avoid overstocking. Overstocking increases the dollar value of a ship's inventory, requires additional stowage space, and cuts into the critical weight allowance aboard ship. Furthermore, overstocking in one ship may cause another ship to be immobilized.

Excess stocks often are built up to ensure that sufficient material is available at all times without immediate recourse to the supply system. Certain parts may require replacement so often that there may be a tendency to consider them as a part of shop stores. Either way, an increase in the quality of manufacture, an improvement in design, or obsolescence may leave the shop store with a 6-year supply of a certain item instead of a 90-day supply.

COORDINATED SHIPBOARD ALLOWANCE LIST

The coordinated shipboard allowance list (COSAL) consolidates the repair parts needed to support all the equipment aboard a given ship. Tailored to meet the needs of individual ships, it is distributed by the Bureau of Ships on a progressive basis according to regular overhaul schedules.

Aboard ship, the COSAL is divided into segments in conformity with equipment category, such as electronic and ordnance segments. A complete copy of the COSAL is retained by the supply department. Other departments receive only the segment for which they have primary

responsibility. For example, the operations officer, the CIC officer, or the electronics material officer might have custody of the electronic segment, regardless of where in the ship a particular electronic equipment is installed.

Each COSAL segment contains an introduction (of interest to all users) and three parts.

Part I (fig. 14-6) is an alphabetical equipment index. For the user's convenience, the index is divided into two sections: section A lists items alphabetically by equipment name; section B lists them alphabetically by function.

Part II of each COSAL segment contains the allowance parts/equipage lists (APLs). As shown in figure 14-7, each APL describes a component shown in part I and lists repair parts, manufacturers' numbers, nomenclature, and stock numbers. For ordering purposes, the last item is the most important. The APLs, then, constitute standardized parts lists for particular equipments. This section of the COSAL is the one used most frequently. For ships not yet using the COSAL, stock numbers required for ordering parts are obtained from the ship's stock number identification table (SNIT) for each equipment.

Part III is a stock number sequence list (SNSL) of all items allowed for support of equipment shown in part I. It also indicates the unit of allowance and storeroom quantity for each repair part in the COSAL. Consolidation of all the SNSLs received on board provides a single source for effecting stock and inventory control.

Ordering Parts

Aboard ships having central storerooms, material for general use of all departments is maintained in storerooms and other spaces under the custody and control of the supply department. Supply personnel keep stock record cards for all items stored, recording receipts and issues of material in order to estimate future requirements of the ship.

On board ships without central storerooms (in general, ships smaller than destroyers), received supplies are turned over directly to department heads. To the extent that space permits, each department maintains its own storeroom. Department heads then are responsible for the accuracy of departmental inventories and for the timely submission of requests for additional repair parts and supplies.

To order parts, a requisition signed by an officer is submitted to the supply officer. Currently, the same form may be used for issues from the ship's storeroom and as a request to procure materials from sources outside the ship. Each requisition bears the part stock number, if available, and a brief description of the requested item. If the stock number is unavailable, a complete written description accompanies the requisition on an additional form provided by the supply department.

COSAL INDEX						SECTION: A
EQUIPMENT AND/OR COMPONENT NOMENCLATURE/CHARACTERISTICS		APPLICATION CODE	ES	QTY.	SIZE	SERVICE APPLICATION
		CODE	INST.	INST.	COM.	
CHAIN ANCHOR 1 1-4IN X SPARES	APL NUMBER	2-260014074			4	MOORING-ANCHOR CHAIN X APPENDAGE
CONTROLLER AC MAG LVP SZ 0 440V ISPD IWDG DRPR		151401453		I		LAUNDRY-WASHING MACHINE
CONTROLLER AC MAG LVP SZ 1 440V ISPD IWDG DRPR		151401154		I		MACHINE SHOP-ENGINE LATHE
NET SLING TYPE FIBER ROPE 10 X 10 FT		2-270014002	♦		3	CARGO HANDLING NETS
PUMP RECIPROCATING HAND DRIVEN DOUBLE ACTING		2-470004002	♦		I	HYDRAULIC VLV CONT RSVR-EMER FLG
RIGGING BLOCK X ROPE DAVIT		2-180014008	♦		I	DEPTH CHARGE HANDLING DAVIT

Figure 14-6. — Part I of the COSAL is an alphabetical equipment index.

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ALLOWANCE PARTS/EQUIPAGE LIST															
NAME OF COMPONENT OR EQUIPAGE		TECHNICAL MANUAL NUMBER (S) OR PLAN NUMBER (S)		COMPONENT OR EQUIPAGE IDENTIFICATION NUMBER		ON BOARD ALLOWANCE TABLES									
CONTROLLER-AC		NAVSHIP PLAN NO. DD445-S9102-2		DATE 8/30/57 151401154		PAGE 1									
DESCRIPTION OF COMPONENT OR EQUIPAGE		NUMBER OF COMPONENTS													
MFR—GENERAL ELECTRIC CO BUSHIPS PLAN NO— MFR DWG-11K1280 MFR IDENTIFICATION—CR5831-J1A CR5831-H1A HP=3 VOLTAGE=440AC AMPS=4.28 PHASE=3 CYCLE=60 OPERATION=MAGNETIC REVERSING TYPE=FULL VOLTAGE HEAT COIL=81D21 ENCLOSURE=DRIPPROOF PATTERN NO=72 EQUIPMENT SPECIFICATION=MIL-C-2212 STOCK NO—		1 2 3 4 5-8 9-20 21-50 51-100													
22D264 431480061 431480062 2242421G11 81D21 2413673 178313 4316428G1		REPAIR PARTS AND RELATED ACCESSORY COMPONENTS													
COIL-RELAY CONTACT-ELECL MVEL CONTACT-ELECL STNRY CONTACT-ELECTRICAL HEAT COIL-THERMAL RELEASE SPRING-HELICAL CMP SPRING-HELICAL CMP TRIP-CKT BRKR		STOCK NUMBERS													
H5950-153-5337 H5945-368-0948 H5945-368-0951 H5945-153-5338 H5950-504-7971 H5930-248-9526 H6110-263-6769 H5925-300-5176		P1 C 1 EA S 1 1 1 1 1 1 2 3 P1 C 6 EA H 6 6 6 6 6 6 12 24 P1 C 12 EA H 12 12 12 12 12 12 24 36 P1 C 2 EA H 2 2 2 2 2 2 4 6 P1 C 2 EA H 2 2 2 2 2 2 4 6 P1 C 6 EA H 6 6 6 6 6 6 12 24 P1 C 1 EA H 6 6 6 6 6 6 12 24 P C 2 EA													
ADDITIONAL NAVSHIP NO/S 391-0673 INCLUDED IN ADDITIONAL PLAN NO/S DD445-S9102-2 11K1280		END													
MFR PART, SERVICE OR DRAWING AND PIECE NUMBER		NOMENCLATURE		STOCK NUMBER		SOURCE CODE	RECY CODE	QTY IN ONE COMP	UNIT OF ALLOWANCE						
									NOTES						
									A/F CODE						
						COMPONENT OR EQUIPAGE IDENTIFICATION NUMBER									
						151401154									

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Figure 14-7.—Part II of the COSAL contains the allowance parts lists.